<u>**Declaration of Robert Jan Maziarz**</u>

I, Robert Jan Maziarz, declare:

I am a citizen of the United Kingdom and a resident of Bristol, United Kingdom.

I have extensive background in the field of welding and, in particular, friction stir welding (FSW) in relation to aircraft components. I have worked at Airbus UK Limited since 1990 as a Structural Design Engineer.

I am currently employed as a Structural Design Engineer by Airbus UK Limited working on Metallic Research projects.

I am one of the three named inventors of the invention which is the subject of US Patent Application No 10/533,177 published as US Publication No 2006/0013645A1.

I have read and am familiar with the subject matter of Patent Application No 10/533,177 and I confirm that I have been given and have read a copy of the currently pending claims of that application. I have also read and am familiar with US Patent No 6,398,883 B1 (Forrest et al).

When manufacturing aircraft components it is sometimes necessary or desirable to weld together thick work-pieces for example solid blocks of aluminium alloy having a thickness of 50mm or greater. The alloy will typically be an aluminium alloy that has been treated so that it has certain mechanical properties necessary for the alloy to be suitable for use in the manufacture of aircraft components. As a result, the microstructure of the alloy is formed of relatively coarse elongate grains that are generally oriented parallel to each other. Welding blocks of aluminium of such a thickness is generally performed by means of a fusion welding

process such as an electron beam (EB) welding process. It is common when joining blocks of aluminium in this way for cracks to form (for example, liquation cracks) in the heat-affected zone (HAZ) next to the weld. Such cracks weaken the welded component particularly under fatigue loading.

Friction Stir Welding (FSW), such as described in Forrest et al, is a process that was known before the priority date (1 November 2002) of the invention. A person of ordinary skill in the art would have known that FSW could be used to produce a fine grain structure.

In Forrest, FSW is used as a post-process application. In other words, FSW is used on an assembled structural assembly in order to produce a fine grain structure. This is done to improve the strength, toughness and fatigue resistance of the structural assembly in order to increase the operational life. Typically, the FSW is performed in regions that will be subject to high operational stresses. This could be at a joint after fusion welding has taken place.

The present invention uses a pre-process application of FSW. Here, FSW is used to enable thick section high-strength aircraft aluminium alloys to be fusion welded together whilst helping to eliminate liquation cracking within the joint. In other words, we discovered that by using FSW on joint surfaces prior to them being fusion welded, liquation cracks within the welded joint can be eliminated.

Liquation cracking is believed to be caused by residual stresses building up in the coarse elongated grains of the HAZ as the weld material rapidly cools (due to the effects of rapid expansion and contraction). Two factors that are relevant to this process being caused are (i) the composition of the aluminium alloy being welded and (ii) the volume of the material being welded. Most high-strength aluminium alloys (such as are often used on aircraft) have a composition that increases the possibility of liquation cracking. In addition, the welding of thick sections also increases the likelihood of liquation cracking. As a result, most high-strength aluminium alloys and thick sections are commonly considered in the aircraft industry to be un-weldable (by fusion welding). This is because the quality of the fusion weld is likely

to be unreliable in-service and could affect the safety of the aircraft. This leads to a high rejection rate on class 1 parts (aircraft parts that, if they fail in service, put the safety of the aircraft at high risk).

The applicant (Airbus) had been looking at existing methods and had tried many new methods for many years before reaching the present idea. I am not aware of any other methods for eliminating (or reducing) liquation cracking.

There is no motivation to adapt Forrest to achieve something similar to the present invention (i.e. FSW on the welding surfaces prior to fusion welding). The motivation in Forrest for using FSW is that fusion welding has increased the operation stress loads of the joint. Hence, FSW is performed because the fusion welding has already taken place. A person of ordinary skill in the art that has reviewed Forrest would not think to use FSW as a preparation step because the only rationale for using FSW in Forrest is as a post-welding step.

There is no disclosure of using FSW before fusion welding in Forrest. Forrest only teaches using FSW after welding and so teaches away from the idea of the present invention.

In the present invention, the use of a surface refinement (FSW) process prior to fusion welding, means that it is possible to produce a class 1 part from a thick section component. This would have been impossible using the process disclosed in Forrest.

Forrest does also not disclose performing FSW on the surfaces that are actually welded together. Instead, FSW is only carried out on the surface left exposed after the fusion weld has taken place. There is also no disclosure of performing any kind of treatment to any of the surfaces to be welded.

Forrest only discloses performing FSW on one surface. It does not disclose using FSW on two surfaces, as in the present invention.

I believe there are many factors that mean that a person of ordinary skill in the art would not come up with the idea of fusion welding two surfaces together that had both been previously treated with a FSW probe, as in the present invention.

All statements made in this declaration of my own knowledge are true and all statements made on information and beliefs are believed to be true.

Signature.......R Maziarz....... (Robert Jan Maziarz)

Date.......8 MAY 2009.......